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Guptail et al.

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(54) **AIR BALANCING FOR VIBRATORY APPARATUS WITH AIR KNIFE**

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(51) **Int. Cl.**
B07C 5/00 (2006.01)

(52) **U.S. Cl.**
USPC **209/44.2**; 209/44; 209/143; 209/466

(58) **Field of Classification Search**
USPC 209/44, 44.2, 143, 466–470
See application file for complete search history.

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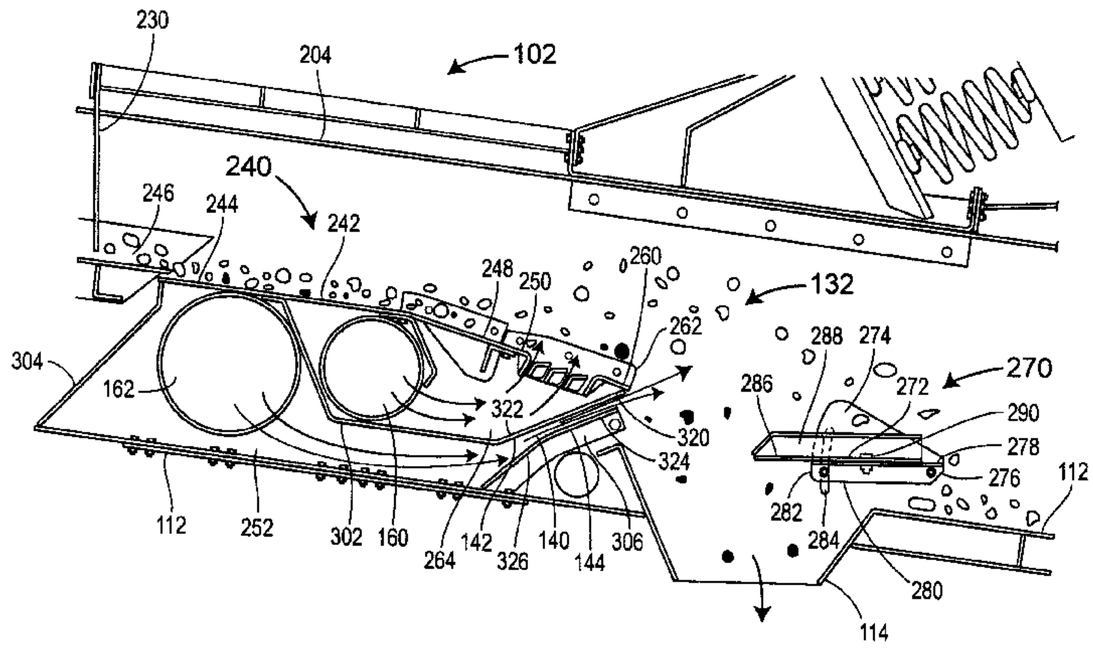
(57) **ABSTRACT**

A system includes a vibratory apparatus with a housing having a floor with an opening and a chamber, a deck disposed in the chamber between the chamber inlet and the opening, a section of the deck having a plurality of apertures and a plenum defined beneath the deck section, and an air knife disposed between the deck section and the chamber outlet. The system includes an air handling system with a first path in communication with the plenum, a second path in communication with the air knife, a third path in communication with a space beneath the air knife, a fourth path in communication with the chamber above the deck between the inlet and the deck section, a return path from the outlet, and an air mover having an outlet in communication with the first, second, third, and fourth paths and an inlet in communication with the return path.

8 Claims, 7 Drawing Sheets



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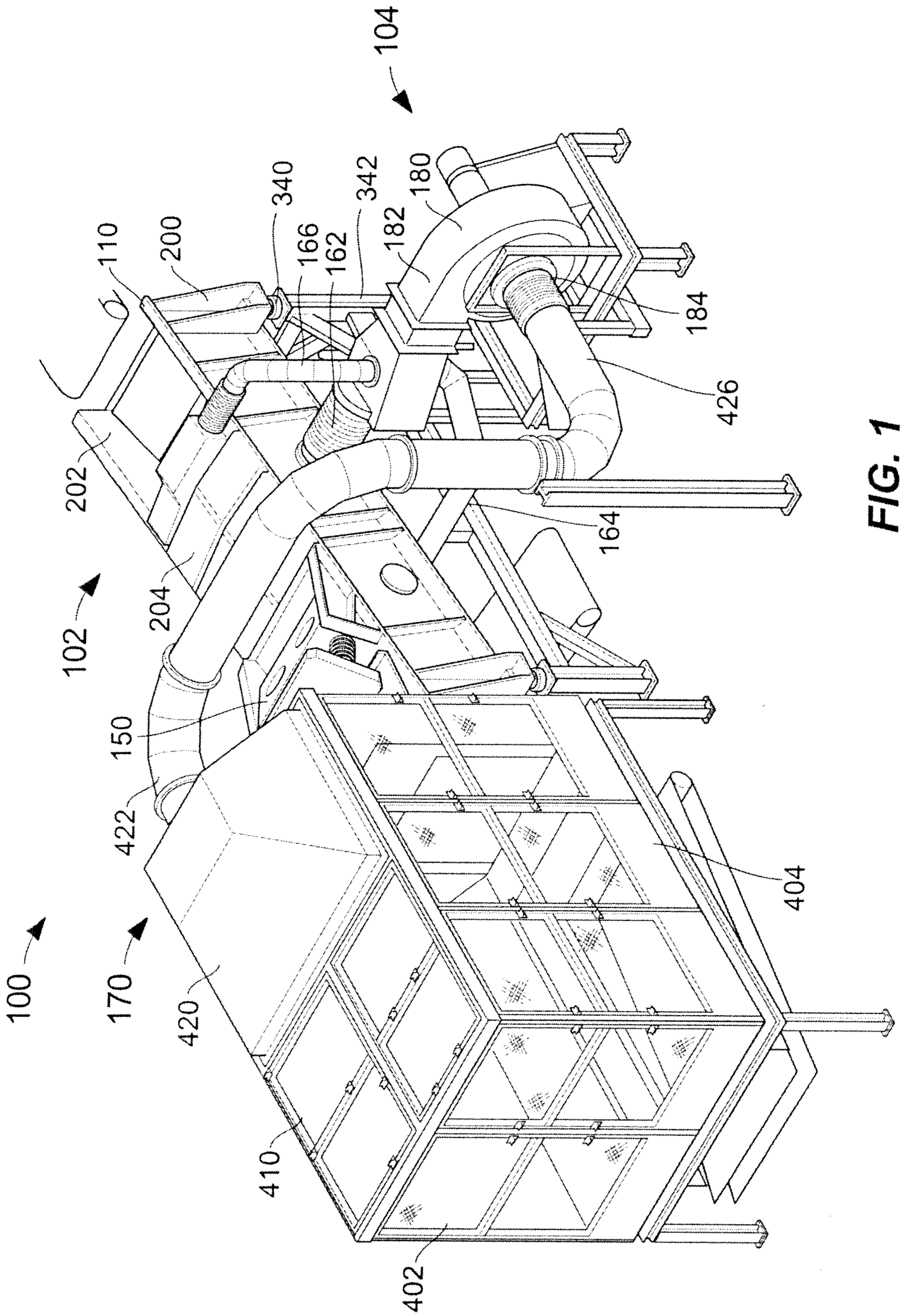
104
110
200
340
342
180
166
162
182
184
426
202
164
204
102
150
422
404
100
170
420
410
402

FIG. 1

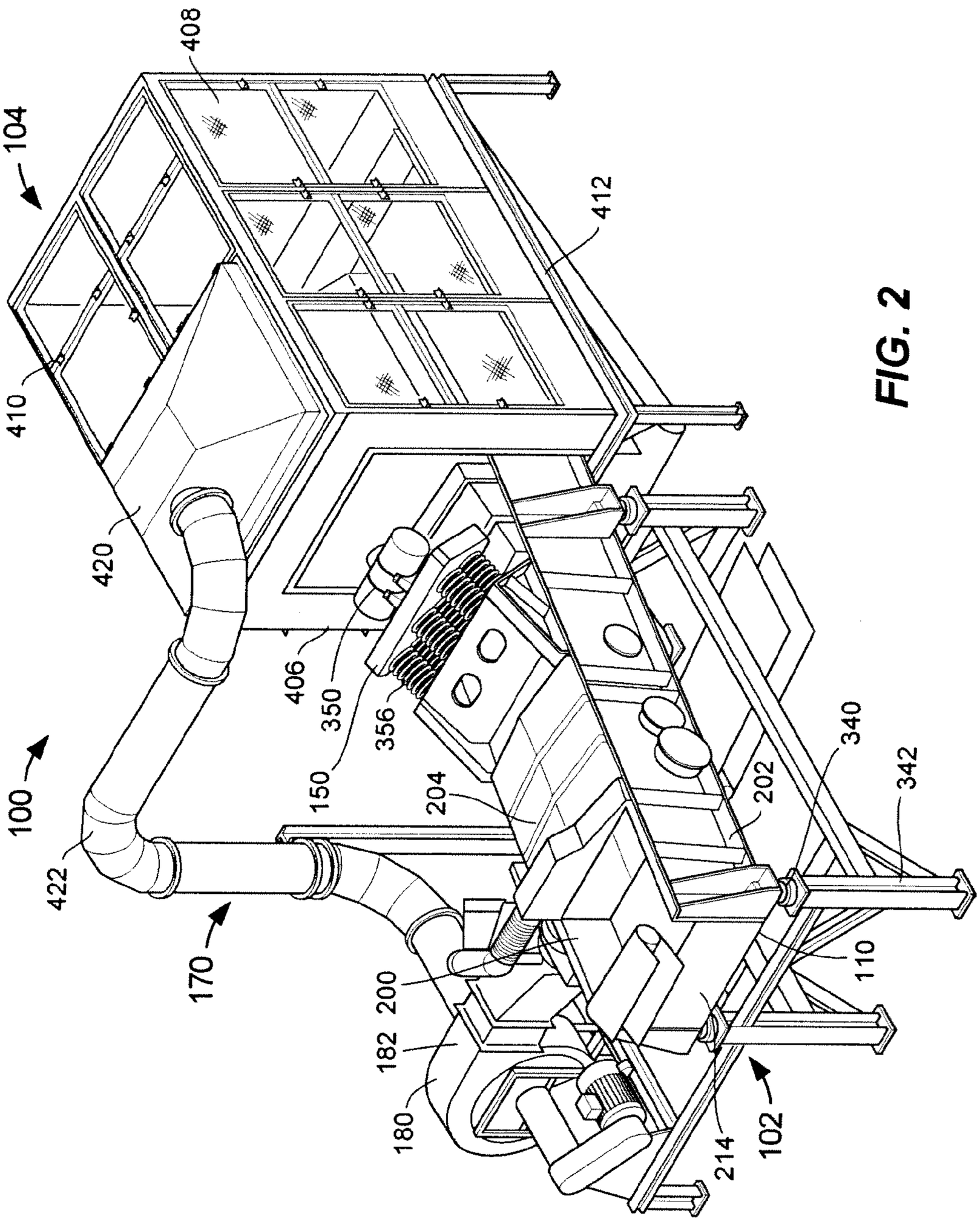
408
104
412
410
420
406
350
356
150
204
202
340
342
422
100
170
200
110
182
180
214
102

FIG. 2

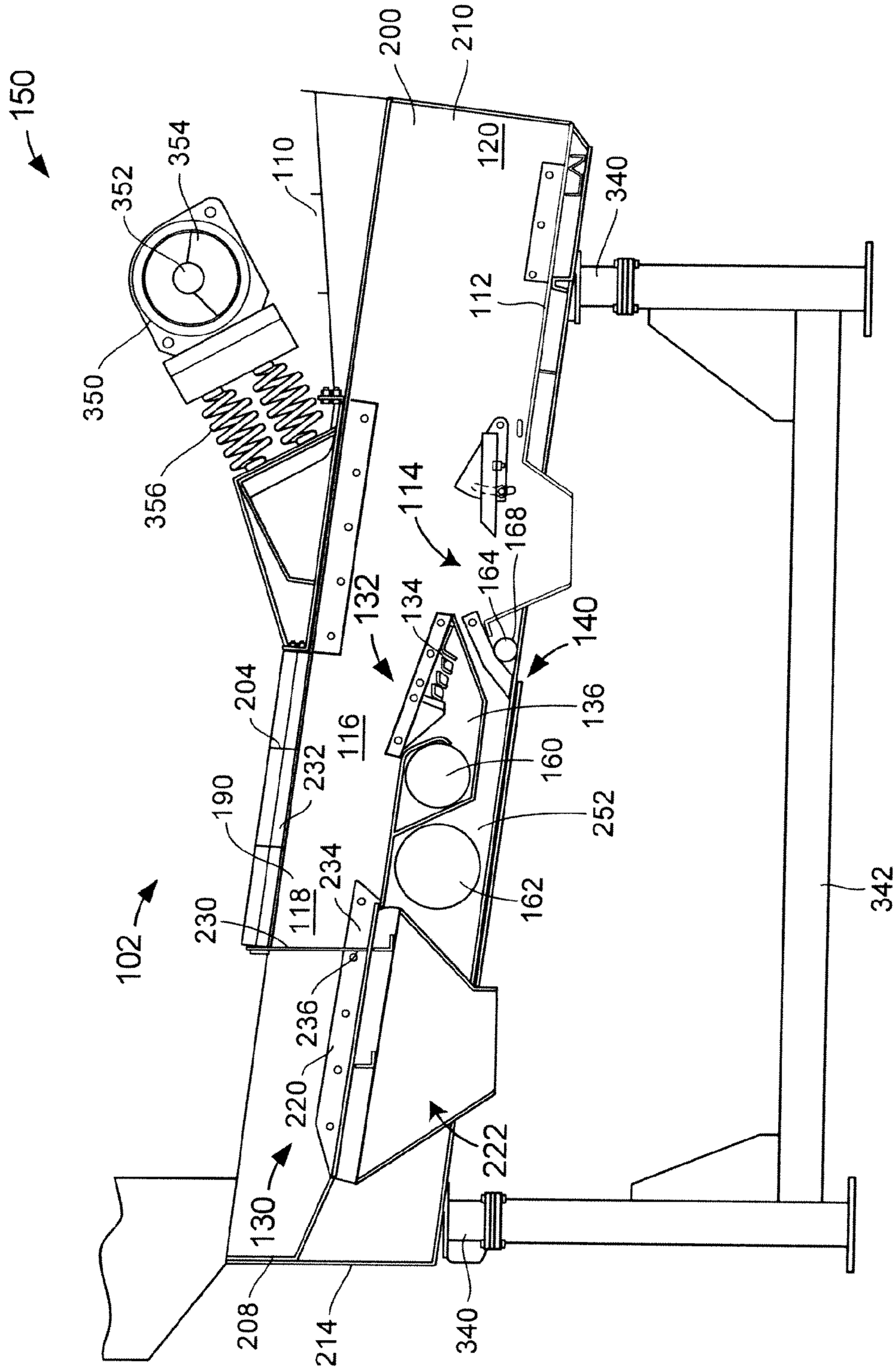
150
352
354
350
356
110
200
210
120
340
112
114
168
164
132
134
140
204
116
136
232
160
190
252
234
118
230
162
102
342
236
220
222
130
208
214
340

FIG. 3

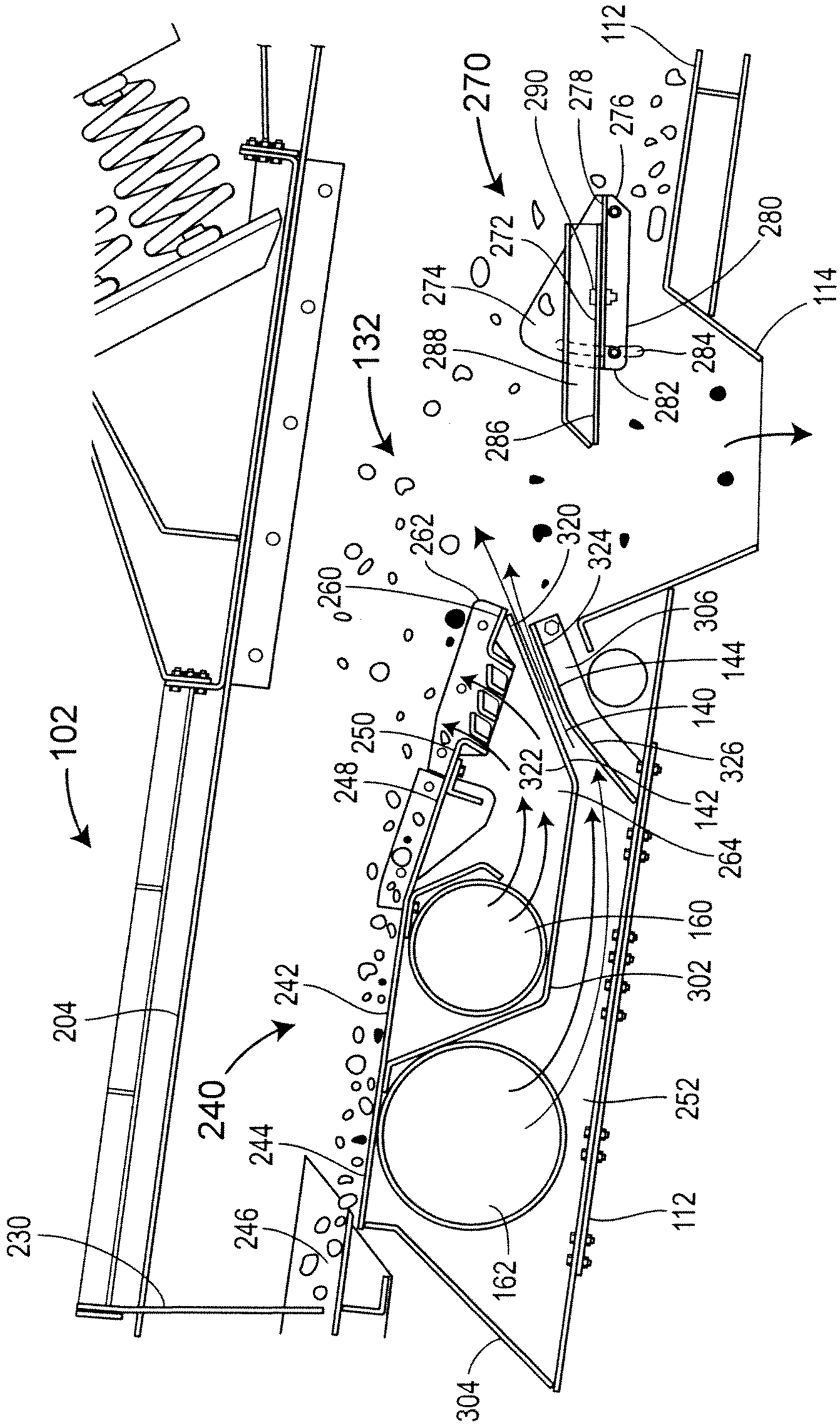
102
204
270
290
278
276
112
272
280
274
114
288
284
282
286
132
262
320
324
260
306
144
140
250
322
326
248
142
264
160
242
302
240
244
252
246
112
230
162
304

FIG. 4

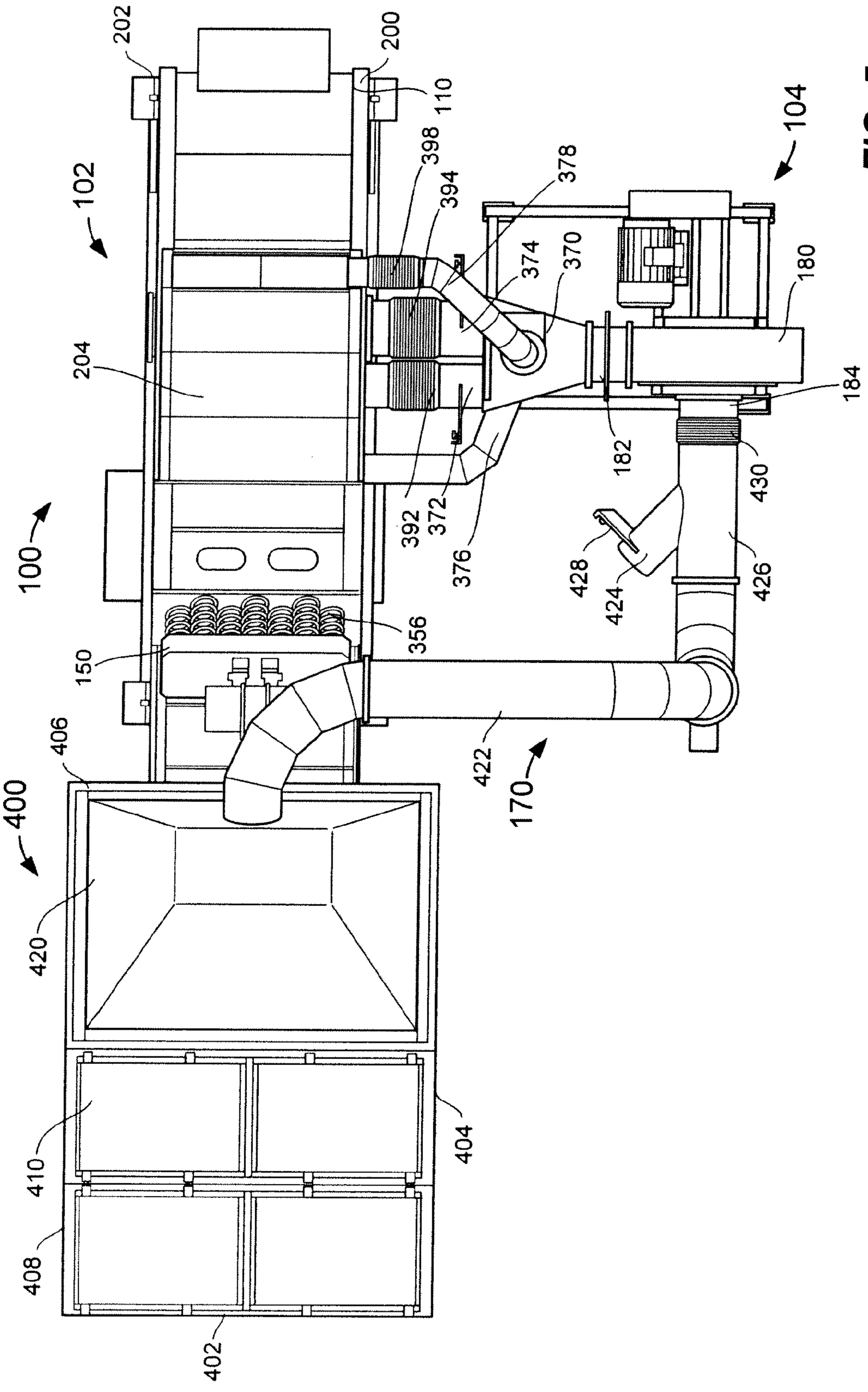
202
200
110
102
104
398
394
378
374
370
180
204
184
182
430
392
372
376
428
424
426
100
356
150
406
422
170
400
420
410
408
404
402

FIG. 5

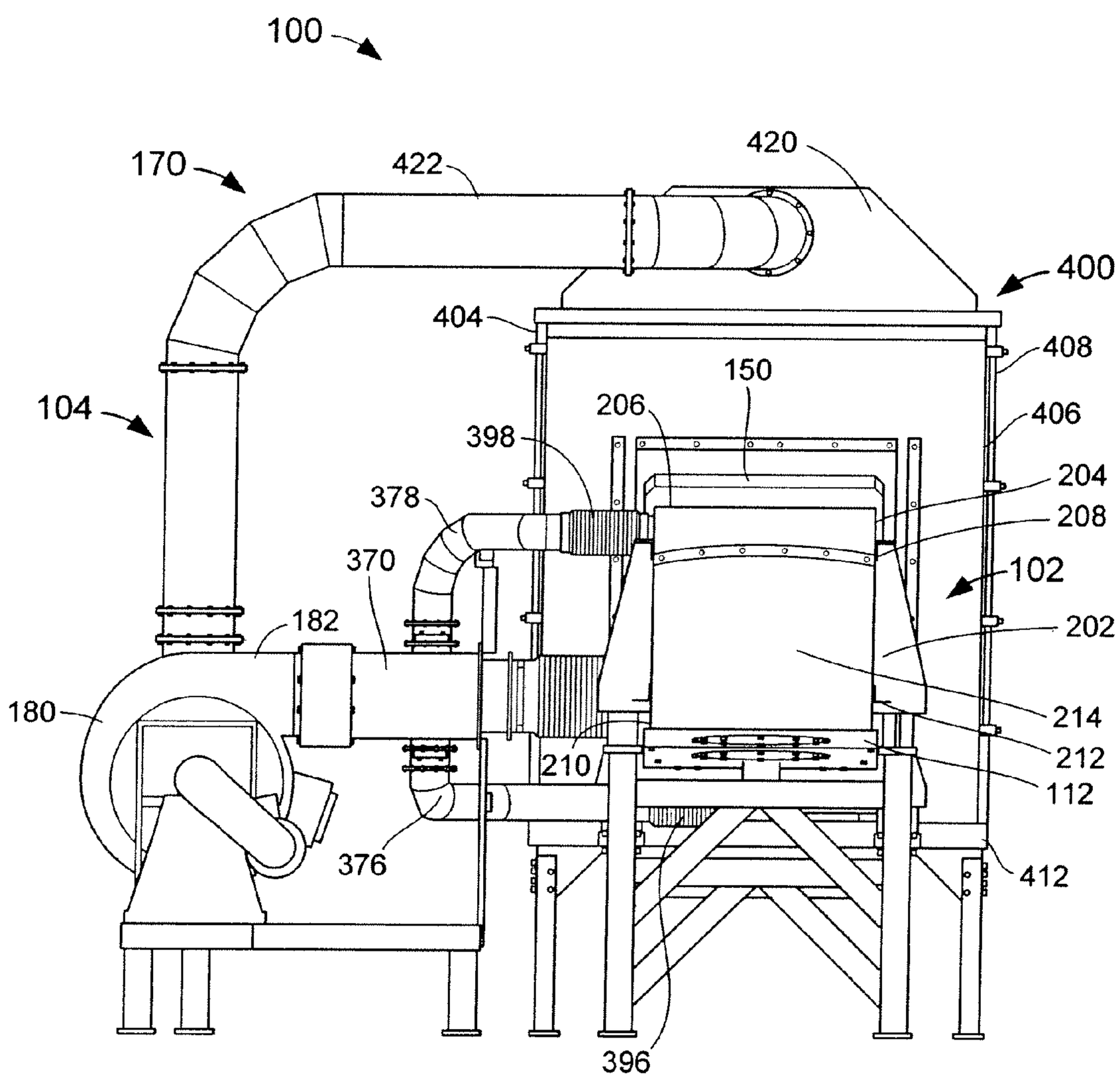
100
170
422
420
400
404
408
150
206
406
104
398
204
378
208
370
102
182
202
180
214
212
210
112
376
412
396

FIG. 6

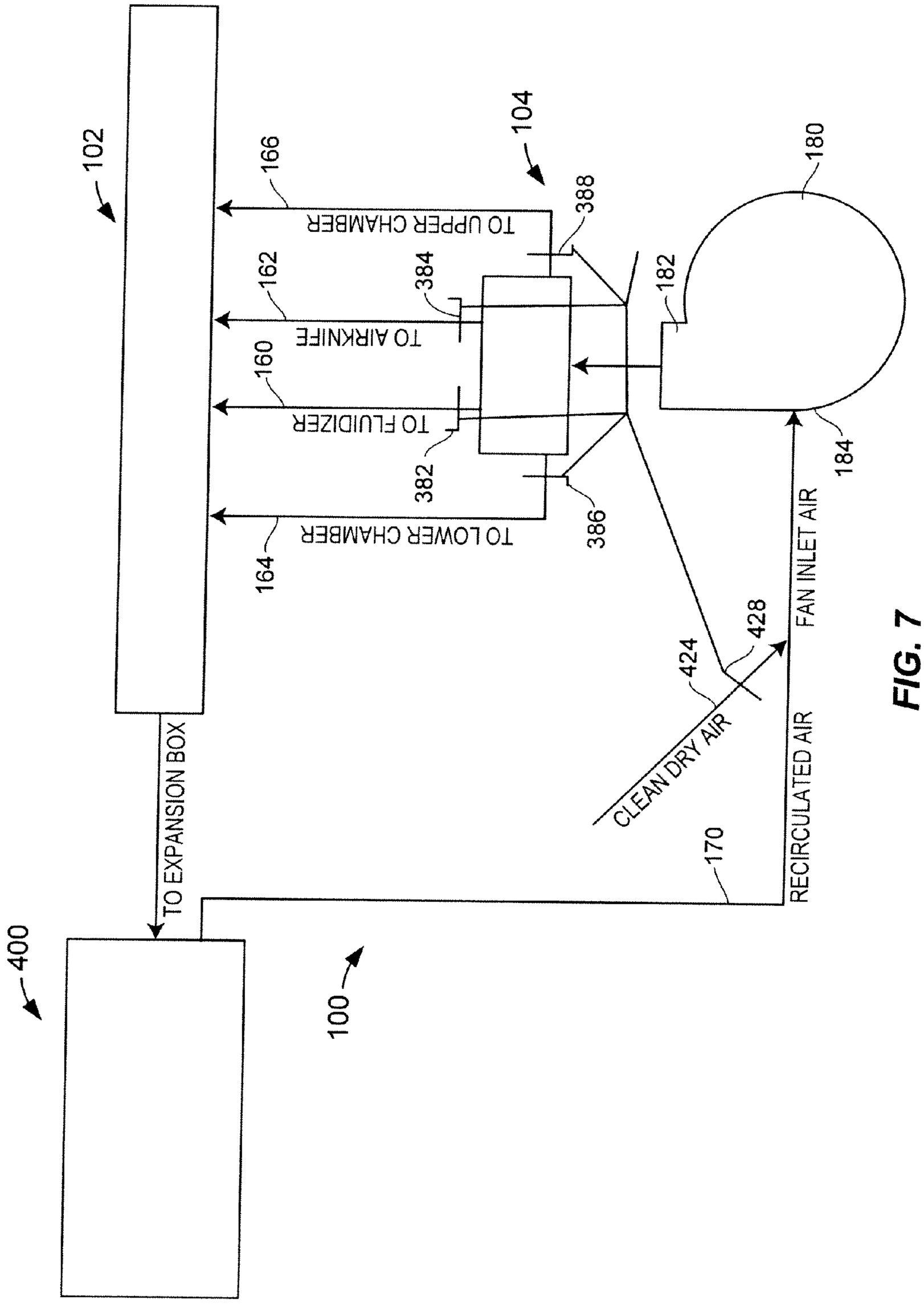
102
166
104
TO UPPER CHAMBER
388
180
162
384
182
TO AIRKNIFE
160
TO FLUIDIZER
382
184
386
TO LOWER CHAMBER
164
424
428
FAN INLET AIR
CLEAN DRY AIR
170
RECIRCULATED AIR
TO EXPANSION BOX
400
100

FIG. 7

AIR BALANCING FOR VIBRATORY APPARATUS WITH AIR KNIFE

BACKGROUND

This patent is directed to air balancing for a vibratory apparatus, and in particular to air balancing for a vibratory apparatus with an air knife.

SUMMARY

According to an aspect of the present disclosure, a system includes a vibratory apparatus and an air handling system. The vibratory apparatus includes a housing having a floor with an opening therethrough, the housing defining a chamber with an inlet and an outlet, a deck disposed in the chamber between the inlet and the opening in the floor, at least a section of the deck having a plurality of apertures to permit air to flow through the section of the deck and a plenum defined beneath the section of the deck, an air knife disposed between the section of the deck and the outlet, the air knife comprising first and second surfaces spaced from each other to guide air therebetween, and a vibration generator coupled to the deck to cause motion of material along the deck. The air handling system includes a first air flow path in communication with the plenum, a second air flow path in communication with the air knife, a third air flow path in communication with a space beneath the air knife, a fourth air flow path in communication with the chamber above the deck between the inlet and the section of the deck, a return air flow path from the outlet of the chamber, and an air mover having an outlet in communication with the first, second, third, and fourth air flow paths and an inlet in communication with the return air flow path.

BRIEF DESCRIPTION OF THE DRAWINGS

It is believed that the disclosure will be more fully understood from the following description taken in conjunction with the accompanying drawings. Some of the figures may have been simplified by the omission of selected elements for the purpose of more clearly showing other elements. Such omissions of elements in some figures are not necessarily indicative of the presence or absence of particular elements in any of the exemplary embodiments, except as may be explicitly delineated in the corresponding written description. None of the drawings is necessarily to scale.

FIG. **1** is a frontal perspective view of a system including a vibratory apparatus with an air knife and an air handling system coupled to the vibratory apparatus;

FIG. **2** is a rear perspective view of a system including a vibratory apparatus with an air knife and an air handling system coupled to the vibratory apparatus;

FIG. **3** is a cross-sectional view of the vibratory apparatus of FIG. **1**;

FIG. **4** is an enlarged, cross-sectional view of the vibratory apparatus of FIG. **1**;

FIG. **5** is a plan view of the system of FIG. **1**;

FIG. **6** is an end view of the system of FIG. **1**; and

FIG. **7** is a schematic view of the system of FIG. **1** illustrating the flow of air through the system.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS

Although the following text sets forth a detailed description of different embodiments of the invention, it should be understood that the legal scope of the invention is defined by the words of the claims set forth at the end of this patent. The detailed description is to be construed as exemplary only and does not describe every possible embodiment of the invention since describing every possible embodiment would be impractical, if not impossible. Numerous alternative embodiments could be implemented, using either current technology or technology developed after the filing date of this patent, which would still fall within the scope of the claims defining the invention.

It should also be understood that, unless a term is expressly defined in this patent using the sentence "As used herein, the term '_____' is hereby defined to mean . . . " or a similar sentence, there is no intent to limit the meaning of that term, either expressly or by implication, beyond its plain or ordinary meaning, and such term should not be interpreted to be limited in scope based on any statement made in any section of this patent (other than the language of the claims). To the extent that any term recited in the claims at the end of this patent is referred to in this patent in a manner consistent with a single meaning, that is done for sake of clarity only so as to not confuse the reader, and it is not intended that such claim term be limited, by implication or otherwise, to that single meaning. Finally, unless a claim element is defined by reciting the word "means" and a function without the recital of any structure, it is not intended that the scope of any claim element be interpreted based on the application of 35 U.S.C. §112, sixth paragraph.

Furthermore, while a certain spatial conventions have been adopted for purposes of illustration, these conventions are not necessarily intended to limit the installation of the system according to the present disclosure. Consequently, terms such as up and down, upstream and downstream, and inner and outer, are simply to facilitate the discussion of the illustrated embodiment as it is shown in the attached drawings.

FIGS. **1-7** illustrate an embodiment of a system **100** including a vibratory apparatus **102** and an air handling system **104**. The air handling system **104** may be connected to the vibratory apparatus **102** at several locations. According to certain embodiments of the present disclosure, the air handling system **104** is used to balance the pressures within the vibratory apparatus **102** so as to maintain a slight negative pressure in the vibratory apparatus **102**. Furthermore, according to such embodiments, the maintenance of the negative pressure with the apparatus **102** is maintained through the use of air recycled within the system **100**.

As seen in FIGS. **1-6**, and more particularly in FIG. **3**, the vibratory apparatus **102** generally includes a housing **110** having a floor **112** with an opening **114** therethrough. The housing **110** defines a chamber **116** with an inlet **118** and an outlet **120**. The apparatus **102** also includes a deck **130** disposed in the chamber **116** between the inlet **118** and the opening **114** in the floor **112**. At least a section **132** of the deck **130** has a plurality of apertures **134** to permit air to flow through the section **132** of the deck **130** and a plenum **136** defined beneath the section **132** of the deck **130**. The apparatus **102** also includes an air knife **140** disposed between the section **132** of the deck **130** and the outlet **120**, the air knife **140** including first and second surfaces **142**, **144** (see FIG. **4**) spaced from each other to guide air therebetween. Further, the apparatus includes a vibration generator **150** coupled to the deck **130** to cause motion of material along the deck **130**.

Furthermore, as seen in FIGS. **1**, **2**, **5** and **6**, the air handling system **104** includes a first air flow path **160** in communication with the plenum **136**, a second air flow path **162** in communication with the air knife **140**, a third air flow path **164** in communication with a space **168** beneath the air knife **140** (see FIG. **3**), and a fourth air flow path **166** in communi-

cation with the chamber **116** above the deck **130** between the inlet **118** and the section **132** of the deck **130** (see also FIG. **3**). Additionally, the air handling system **104** includes a return air flow path **170** from the outlet **120** of the chamber **116**. An air mover **180** is included in the air handling system **104** with an outlet **182** in communication with the first, second, third, and fourth air flow paths **160**, **162**, **164**, **166** and an inlet **184** in communication with the return air flow path **170**.

In operation, air exiting the air knife **140** has a tendency to create a negative pressure in the space **168** beneath the air knife **140**. Further, a negative pressure may be created in the general area **190** (FIG. **3**) above the deck **130** between the inlet **118** to the chamber **116** and the section **132** of the deck **130**. The negative pressure beneath the air knife **140**, if not balanced, may cause the air exiting the knife **140** to be deflected in the direction of the floor **112** and may cause unwanted changes in the paths of materials passing through apparatus **102**. Similarly, the negative pressures in the area **190** above the deck **130** can cause unwanted motion in the material passing through the apparatus **102**.

The air handing system **104** according to the present disclosure provides an offsetting air flow to balance the negative pressure that would otherwise develop in the space **168**. As a consequence, the path of the material flowing past the knife **140** may be more predictable, providing for better and more predictable separation of the materials. A similar improvement in predictability may be achieved when the offsetting air flow is provided to the space **190**. Moreover, where the offsetting flows are provided from air recycled from the outlet **120** of the chamber **116**, the system **100** limits the amount of air exiting the system **100** that must otherwise be processed before it can be released.

It will be recognized that while air flow paths **164**, **166** have been provided to balance the negative pressures that build below the air knife **140** and within the chamber **116**, both air flow paths **164**, **166** need not be provided in every embodiment of the system **100** according to the present invention. For that matter, it is not a requirement that the fluidizing stage defined by section **132** of the deck **130** be provided according to every embodiment. It is possible, according to the present disclosure, simply to provide the third air flow path **164** to balance the negative pressure that builds under the air knife **140**, thereby preventing this negative pressure to draw air into the housing **110** in an uncontrolled fashion and/or amount.

Each of the apparatus **102** and the air handling system **104** is now discussed in greater detail relative to FIGS. **1-7**. It will be appreciated that the illustrated embodiments are simply one embodiment according to the present disclosure. As is noted herein, certain structures illustrated in FIGS. **1-7** may be absent in other embodiments while remaining with the scope of the present disclosure.

Starting first with the apparatus **102**, and referring in particular to FIGS. **3**, **4** and **6**, the housing **110** may include side walls **200**, **202** and a top wall, or hood, **204**, in addition to the floor **112**. It will be recognized with reference to FIG. **6** that the side walls **200**, **202** may have first ends **206**, **208** attached to the floor **112** and second ends **210**, **212** attached to the top wall **204**. As such, the housing **110** forms a rectangular, parallelepiped shape as illustrated, although this should be viewed as an exemplary arrangement only.

The apparatus **102** may also include an end wall **214** (FIG. **3**) that is attached to the side walls **200**, **202**. Edges of the side walls **200**, **202**, the top wall **204** and the end wall **214** define the inlet **118** to the chamber **116**. While an end wall may be disposed at the opposite end of the housing **110**, the illustrated embodiment lacks such an end wall. Instead, the edges of the floor **112**, side walls **200**, **202** and top wall **204** define the outlet **120**.

As seen in FIG. **3**, the deck **130** is disposed within the housing **110**, and may be attached to the housing **110** by securing the edges of the deck **130** to the side walls **200**, **202** of the housing **110**, as is illustrated in FIG. **3** relative to side wall **200**. In this regard, the deck **130** or sections thereof may have one or more brackets that are fastened to the side walls **200**, **202** through the use of fasteners, such as bolts. As noted above, the deck **130** may include at least one section **132** that is in communication with the air handling system **104**. However, as illustrated, the deck **130** includes other sections as well.

Starting then at the inlet end **118** of the chamber **116**, a first section **220** of the deck **130** may have a plurality of apertures therethrough, with a chute **222** disposed below the first section **220** of the deck **130**. The first section **220** may be referred to as a separation stage. The plurality of apertures may be defined by a mesh or screen, and may be used for an initial separation of materials entering the vibrator apparatus **102**. Materials of a certain size and weight may pass through the first section **220** of the deck **130** and the chute **222**. For example, the section **220** may include a plurality of apertures sized to allow particles below one-half inch in size to pass through. The materials passing through the chute **222** may be directed onto a separate conveyor, which may be a vibratory conveyor or a belt conveyor, for example. It will be recognized that according to variants, this section **220** may be replaced with a solid plate instead (thereby eliminating the separation action of this section of the deck **130**).

The material that moves along the deck **130** past the first section **220** may pass under the top wall or hood **204**. A flexible flap or curtain **230** may depend from an inner surface **232** of the hood **204**, and may extend to an upper surface **234** of the deck **130**. A lower edge **236** of the curtain **230** may abut the upper surface **234** of the deck **130**, or may be spaced therefrom. The curtain **230** may be constructed of any suitable material, including, for example, cloth, rubber, and/or the like. The curtain **230** may assist confining the materials to the section of the chamber **116** between the curtain **230** and the outlet **120** of the chamber.

As better seen in FIG. **4**, a second section **240** of the deck **130** may extend between the first section **220** and the section **132**. The second section **240** may be defined by a deck plate **242** that has no apertures therethrough, unlike the sections **220**, **132**. An upstream end **244** of the plate **242** may abut a downstream end **246** of the first section **220**, while a downstream end **248** may abut an upstream end **250** of the section **132** described above. The second section **240** of the deck **132** may also define, at least in part, the plenum **136** and a chamber **252** in communication with the air knife **140**, as will be described in greater detail below.

The third section of the deck **130** is the section **132** discussed above with reference to FIG. **3**, through which air from the first air flow path passes. As mentioned above, the section **132** has a plurality of apertures **134** therethrough. Although the apertures **134** may be defined by any number of different structure, the apertures **134** may be defined using a screen, and in particular a finger screen **260**, as is illustrated in FIG. **4**. A downstream end **262** of the section **132**, and thus the finger screen **260**, is proximate to the air knife **140**; in particular, the downstream end **262** abuts a plate **264** used to define one of the surfaces **142**, **144** of the air knife.

The section **132** of the deck **130** acts to fluidize the material moving over the screen **260**. As such, the size of the apertures **134** may vary; bark chunks may require more fluidizing air

and therefore may require larger apertures **134**, while saw dust may require less fluidizing air and therefore may require smaller apertures **134**, for example. Further, air passing through the apertures **134** causes the material passing over the deck **130** to tumble, agitating any large, bound-together clumps. The fluidizing air works the various sized parts of the disintegrating clumps, allowing the heavier fraction to collect at the bottom, or lower level, of the bed and the lighter, loose particles to bob and jump at the upper level of the bed. As a further consequence, the heavier particles may fall through the adjustable air stream formed by the air knife **140** into the opening **114** while the lighter particles may be picked up by the air stream formed by the air knife **140**.

Between the air knife **140** and the outlet **120** of the chamber **116** is the opening **114** in the floor **112**. The opening **114** may be referred to as a dropout opening. Once the materials moving along the deck **130** become fluidized while passing over section **132** of the deck **130**, the materials pass over the air knife **140**, which causes certain of the materials to be blown out over the opening **114**, while other materials pass into the opening **114**. To permit a greater adjustability as to the selectivity of the separation caused by the air knife **140**, the apparatus **102** may include a plate assembly **270** (which may be referred to as a landing plate) that may have an adjustable length and angular position, as is illustrated in FIG. **4**.

In particular, the plate assembly **270** may includes a first plate **272** having side plates disposed on either side, one of the side plates **274** being shown in FIG. **4**. The side plates **274** are pivotally attached at a first end **276** through the use of a pivot rod **278**, for example, that passes through the side walls **200**, **202** is secured thereto by, for example, using fasteners such as nuts and bolts. A second end **280** is attached to an adjustment mechanism, which may include a second rod **282** that is received in an arcuate slot **284**, which rod may be secured in a particular position along the slot **284** to selectively secure the plate assembly **270** in a particular angular position. A second, extension plate **286** is translatably mounted on the first plate **272**, and is translatable toward and away from the opening **114**. The extension plate **286** also has side walls **288**, and fasteners **290** that may be used to selectively secure the plate **286** relative to the plate **272**.

Turning now to the space below the second and third sections **240**, **132** of the deck **130**, it will be recognized that two chambers or plenums are defined between the deck **130** and the floor **112** of the housing **110**. One of these chambers is the plenum **136**, while the other is the chamber **252** in communication with the air knife **140** and the second air flow path **162**. In particular, the plenum **136** is defined at either side by the side walls **200**, **202**, above by the deck plate **242** and the finger screen **260**, and below by a separation plate **302** (part of which may define the plate **264**). The plenum **300** is defined at either side by the side walls **200**, **202**, above by the deck plate **242** and the separation plate **302**, below by the floor **112**, at one end by an end plate **304** that defines in part the chute **222**, and at the other end by an adjustable deflector plate **306**.

In the illustrated example, the portion **264** of the separation plate **302** and the deflector plate **306** may define the surfaces of **142**, **144** of the air knife **140**. The first surface **142** of the air knife **140** (and thus the plate **264**, for example) has a first end **320** and a second end **322**, and the second surface **144** of the air knife **140** (and thus the plate **306**) has a corresponding first end **324** and a corresponding second end **326**. The second surface **144** is translatable between a first position, wherein the second surface **144** is shifted towards the first surface **142** so that the first ends **320**, **324** and second ends **322**, **326** of the first and second surfaces **142**, **144** have a first spacing therebetween, and a second position, wherein the second surface **144** is shifted away from the first surface **142** so that the first ends **320**, **324** and second ends **322**, **326** of the first and second surfaces **142**, **144** have a second spacing therebetween, the second spacing being larger than the first spacing.

The first, or narrow, spacing may provide a high velocity air stream from the air knife **140**. The high velocity air stream may be well suited for separating two or more commingled, relatively light objects, such as paper and glass. The second, wider, spacing may provide a lower velocity air stream. The low velocity air stream may be well suited for separating other, heavier commingled objects, such as wood and rock.

The apparatus **102** may be suspended, as illustrated such that the housing **110** slopes generally downward from the inlet **118** towards the outlet **120** to assist in motion of the mixture as described below. As seen in FIGS. **1-3**, resilient isolation members **340** may be disposed between the housing **110** and a frame **342** that is disposed on the ground, for example. The resilient members **340** may be, for example, marshmallow-type springs. It will be appreciated, however, that any other suitable spring, or suspension system for that matter, may be used.

As also seen in FIGS. **1-3**, the apparatus **102** includes a vibration generator **150**, an exemplary embodiment of which is illustrated. As illustrated in FIG. **3**, the generator **150** includes a motor **350** having a shaft **352** with a pair of eccentric weights **354** (only one of which is illustrated in FIG. **3**) mounted at the ends thereof. The motor **350** is coupled to the housing **110** via on or more resilient members **356**, which may be coil springs as illustrated and may be referred to as reactor springs. The vibration generator **350** is thus a two-mass system, although it will be recognized that brute force and other type of generators may also be used with the apparatus **102** according to the present disclosure.

Turning now to the air handling system **104** as illustrated in FIGS. **1**, **2** and **5-7**, each of the air flow paths **160**, **162**, **164**, **166**, **170** is defined by at least one or more conduits. Certain of these air flow paths also include one or more dampers, or slide gates, to control the flow of air through the conduits. It will be recognized that the dampers permit a single air mover, in the form of a centrifugal fan, for example, to be used for all of the air flow paths. According to alternative embodiments, the air flow paths **160**, **162**, **164**, **166** may have their own separate air movers associated therewith, and the control of the flow of the air through these paths **160**, **162**, **164**, **166** may be through the use of variable frequency drives instead of dampers. At least one of these paths, the return air flow path **170**, may include devices other than conduits and dampers; as illustrated, the return air flow path may include an expansion box and a fresh air inlet.

Starting then at the outlet **182** of the air mover **180** with reference to FIGS. **5** and **6**, a single conduit **370** branches into four conduits **372**, **374**, **376**, **378**, one each for each of the four air flow paths **160**, **162**, **164**, **166**. As illustrated in FIG. **7**, each of the conduits **372**, **374**, **376**, **378** has a damper **382**, **384**, **386**, **388** associated therewith. Further, each conduit **372**, **374**, **376**, **378** has a flexible connector **392**, **394**, **396**, **398** associated therewith (see FIGS. **5** and **6**); the flexible connectors **392**, **394**, **396**, **398** accommodate the movement of the vibratory apparatus **102** during operation of the system.

The return air flow path **170** includes more than conduits, dampers and connectors. As illustrated in FIGS. **1**, **2**, and **5-7**, the return air flow path **170** includes an air expansion box **400** connected to the outlet **120** of the chamber **116**. The air expansion box **400** has walls **402**, **404**, **406**, **408**, **410** defined by one or more panels made of a mesh material, for example. The bottom **412** of the box **400**, by contrast, is open to a conveyor, such as a belt conveyor as illustrated. The box **400**

permits the air exiting the outlet **120** to undergo expansion upon exiting the apparatus **102**.

The wall **410** is also defined in part by a hood **420** that collects the air entering the box **400**, and directs the air into a conduit **422**. The conduit **422** is connected to an inlet **424** (see FIGS. **5** and **7**) through which fresh air from the surrounding environment may enter the air handling system **104** at a Y-connection **426**. The inlet **424** is covered by a damper **428**, which may be moved between an open state and a closed state to control the amount of fresh air entering the system **104**. The Y-connection **426** is connected to the inlet **184** of the air mover **180** via a flexible connector **430**.

While no system has been illustrated for the automated operation of the air handling system **104** has been illustrated, it will be recognized that the manual operation of the air mover **180** and the dampers **382**, **384**, **386**, **388**, **428** may be coordinated using automated methods. For example, one or more controllers may be connected to control the operation of the air mover **180** (through the use of a variable frequency drive, for example) and the movement of the dampers **382**, **384**, **386**, **388**, **428** (through the use of electromechanical actuators) so as to permit the air handling system **104** to be controlled from a single point, if not by a single controller. The control of the air handling system **104** may even be automated to as to be coordinated with the operation of the apparatus **102** to permit unified control of the entire system **100**.

In operation, an air flow may be selected for the first and second air flow paths **160**, **162** so as to optimize the fluidization and separation of the material passing through the apparatus **102** with the vibration generator **150** operating to move material along the deck **130**. At the same time, air flow may be selected for the third air flow path **164** to balance the negative air pressure that builds below the air knife **140** to maintain a slight negative pressure within the chamber **120**. Similarly, air flow may be selected for the fourth air flow path **166** to balance the negative pressure that builds upstream of the section **132** of the deck **130** to maintain the slight negative pressure. The air for each of the paths **160**, **162**, **164**, **166** is obtained from the return air flow path **170**, and potentially the fresh air inlet **424**. The selection of the air flows **160**, **162**, **164**, **166** may involve control of the operation of the air mover **180**, as well as movement of the dampers **382**, **384**, **386**, **388** and **428**.

It will be recognized that the system according to the present disclosure may present one or more advantages relative to prior systems. According to any particular embodiment of the present system, any or all of these advantages may be present.

What is claimed is:

1. A system comprising:

(i) a vibratory apparatus comprising:

a housing having a floor with an opening therethrough, the housing defining a chamber with an inlet and an outlet,

a deck disposed in the chamber between the inlet and the opening in the floor, at least a section of the deck having a plurality of apertures to permit air to flow through the section of the deck and a plenum defined beneath the section of the deck,

an air knife disposed between the section of the deck and the outlet, the air knife comprising first and second surfaces spaced from each other to guide air therebetween,

a vibration generator coupled to the deck to cause motion of material along the deck; and

(ii) an air handling system comprising:

a first air flow path in communication with the plenum,

a second air flow path in communication with the air knife,

a third air flow path in communication with a space beneath the air knife,

a fourth air flow path in communication with the chamber above the deck between the inlet and the section of the deck,

a return air flow path from the outlet of the chamber, and

an air mover having an outlet in communication with the first, second, third, and fourth air flow paths and an inlet in communication with the return air flow path.

2. The system according to claim **1**, wherein the third air flow path is disposed below the second surface of the air knife.

3. The system according to claim **1**, wherein each of the first, second, third, and fourth air flow paths is defined in part by a conduit having a damper disposed therein to control the flow of air through each of the first, second, third, and fourth air flow paths.

4. The system according to claim **1**, wherein the system comprises an air expansion box disposed between the outlet of the chamber and the inlet of the air mover, the air expansion box comprising a housing having walls defined by mesh panels.

5. The system of claim **1**, wherein the inlet of the air mover is also in communication with a fresh air inlet in communication with the environment.

6. The system according to claim **1**, wherein the deck is attached to the housing and spaced from the floor.

7. The system according to claim **1**, wherein the section of the deck has an upstream end and a downstream end, the air knife disposed at the downstream end of the section of deck.

8. The vibratory apparatus according to claim **1**, wherein:

the first surface of the air knife has a first end and a second end, and the second surface of the air knife has a corresponding first end and a corresponding second end,

the second surface being translatable between a first position, wherein the second surface is shifted towards the first surface so that the first ends and second ends of the first and second surfaces have a first spacing therebetween, and a second position, wherein the second surface is shifted away from the first surface so that the first ends and second ends of the first and second surfaces have a second spacing therebetween,

the second spacing being larger than the first spacing.

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